

**2017 IEEE International
Conference on Pervasive
Computing and Communications
Workshops
(PerCom Workshops 2017)**

**Kona, Big Island, Hawaii, USA
13-17 March 2017**



**IEEE Catalog Number: CFP17344-POD
ISBN: 978-1-5090-4339-2**

**Copyright © 2017 by the Institute of Electrical and Electronics Engineers, Inc
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP17344-POD
ISBN (Print-On-Demand):	978-1-5090-4339-2
ISBN (Online):	978-1-5090-4338-5

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

First International Workshop on Annotation of useR Data for Ubiquitous Systems'17 - Program

Friday, March 17, 09:00 - 10:00

ARDUOUS-keynote: Keynote Session

Good pervasive computing studies require laborious data labeling efforts: Our experience in activity recognition and indoor positioning studies

Takuya Maekawa

Chair: Adeline Paiement (Swansea University, United Kingdom)

Preparing and labeling sensing data are necessary when we develop state-of-the-art sensing devices or methods in our studies. Since developing and proposing new sensing devices or modalities are important in the pervasive computing and ubicomp research communities, we need to provide high quality labeled data by making use of our limited time whenever we develop a new sensing device. In this keynote talk, we first introduce our recent studies on activity recognition and indoor positioning based on machine learning. Later, we discuss important aspects of producing labeled data and share our experiences gathered during our research activities.

Good pervasive computing studies require laborious data labeling efforts: Our experience in activity recognition and indoor positioning studies 1

Takuya Maekawa (Osaka University, Japan)

Friday, March 17, 10:30 - 12:00

ARDUOUS-S1: Short Presentation of Accepted Papers

Chair: Kristina Yordanova (University of Rostock, Germany)

A Smart Data Annotation Tool for Multi-Sensor Activity Recognition 111

Alexander Diete, Timo Szttyler and Heiner Stuckenschmidt (University of Mannheim, Germany)

Personal context modelling and annotation 117

Fausto Giunchiglia, Enrico Bignotti and Mattia Zeni (University of Trento, Italy)

Talk, text or tag? The development of a self-annotation app for activity recognition in smart environments 123

Przemyslaw Woznowski, Emma Tonkin, Pawel Laskowski and Niall Twomey (University of Bristol, United Kingdom); Kristina Yordanova (University of Rostock, Germany); Alison Burrows (University of Bristol, United Kingdom)

On the Applicability of Clinical Observation Tools for Human Activity Annotation 129

Frank Krüger (University of Rostock, Germany); Christina Heine (Universität Rostock, Germany); Sebastian Bader and Albert Hein (University of Rostock, Germany); Stefan Teipel (DZNE, Germany); Thomas Kirste (University of Rostock, Germany)

Evaluating the use of voice-enabled technologies for ground-truthing activity data 135

Przemyslaw Woznowski, Alison Burrows, Pawel Laskowski, Emma Tonkin and Ian Craddock
(University of Bristol, United Kingdom)

Labeling Subtle Conversational Interactions 140

Michael Edwards, Jingjing Deng, Xianghua Xie and Adeline Paiement (Swansea University, United Kingdom)

NFC based dataset annotation within a behavioral alerting platform 146

Joseph Rafferty and Jonathan Synnott (Ulster University, United Kingdom); Chris Nugent (University of Ulster, United Kingdom); Gareth Morrison (The Lava Group, United Kingdom); Elena Tamburini (I+ S. r. l, Italy)

Engagement Issues in Self-Tracking Lessons Learned from User Feedback of Three Major Self-Tracking Services 152

Carl M Olsson (Malmö University & Internet of Things and People Research Center, Sweden)

Friday, March 17, 13:15 - 14:00

ARDUOUS-S2: Poster Session

Chair: Adeline Paiement (Swansea University, United Kingdom)

Friday, March 17, 14:00 - 14:45

ARDUOUS-S3: Live Annotation Session

Chairs: Albert Hein (University of Rostock, Germany), Emma Tonkin (University of Bristol, United Kingdom)

Friday, March 17, 15:15 - 16:45

ARDUOUS-S4: Panel Discussion

How to improve annotation tools and techniques to increase their efficiency and accuracy?

Chairs: Adeline Paiement (Swansea University, United Kingdom), Kristina Yordanova (University of Rostock, Germany)

Friday, March 17, 16:45 - 17:00

ARDUOUS-S5: Wrap-up

Chair: Kristina Yordanova (University of Rostock, Germany)

First IEEE International Workshop on Behavioral Implications of Contextual Analytics (PerCom Workshops) 2017 - Program

Friday, March 17, 09:00 - 12:00

BICA-S1: Contexts and Behaviors

Size Efficient Big Data Sharing Among Internet of Things Devices 158

Sungmin Cho (The University of Texas at Austin, USA); Christine Julien (University of Texas at Austin, USA)

SoccerMate: A Personal Soccer Attribute Profiler using Wearables 164

H M Sajjad Hossain (University of Maryland Baltimore County, USA); Md Abdullah Al Hafiz Khan (University of Maryland, Baltimore County, USA); Nirmalya Roy (University of Maryland Baltimore County, USA)

Your Data in Your Hands: Privacy-preserving User Behavior Models for Context Computation 170

Rahul Murmuria and Angelos Stavrou (Kryptowire, USA); Daniel Barbara (George Mason University, USA); Vincent Sritapan (DHS, USA)

A Novel Secured Traffic Monitoring System for VANET 176

Shereen Taie (Fayoum University, Egypt); Sanaa Taha (Cairo University, Egypt)

CSO-Based Algorithm with Support Vector Machine 183

Shereen Taie (Fayoum University, Egypt); Wafaa Ghonaim (Faculty of Science, Al-Azhar University, Egypt)

SenseGen: A Deep Learning Architecture for Synthetic Sensor Data Generation 188

Moustafa Alzantot (University of California Los Angeles, USA); Supriyo Chakraborty (IBM T. J. Watson Research Lab, USA); Mani B. Srivastava (University of California, Los Angeles, USA)

The Fourth International Workshop on Crowd Assisted Sensing, Pervasive Systems and Communications 2017 - Program

Monday, March 13, 09:00 - 10:00

CASPer-keynote: Keynote

Human Factors in Crowd-Assisted Sensing

Delphine Reinhardt

Chair: Salil S Kanhere (The University of New South Wales, Australia)

Abstract

The paradigm of crowd-assisted sensing primarily relies on volunteers, who use their personal devices to collect sensor information. To foster participants' contributions and hence ensure the viability of the underlying applications, different approaches, such as novel incentive schemes and privacy-preserving mechanisms, have been proposed. In most cases, these approaches have been evaluated by means of simulations and proof-of-concept implementations. While these evaluations are necessary to measure the efficacy and performance of the introduced solutions, they often neglect the human factors, despite their central role in crowd assisted applications. In my keynote, I will therefore emphasize on these aspects by presenting different studies, which my research team and I have conducted in the last years. Covered challenges range from the exploration of attitudes to participatory sensing tasks in location-based gaming communities to the participants' expectation in terms of rewards based on the invested resources. Our studies share common goals including analyzing the requirements from the perspective of potential users, which may contribute to their acceptance of novel solutions as well as motivate them to engage in crowd-assisted sensing applications in both short- and long-term.

Human Factors in Crowd-Assisted Sensing 194

Delphine Reinhardt (University of Bonn and Fraunhofer FKIE, Germany)

Monday, March 13, 10:30 - 12:00

CASPer-S1: Technical Session 1: Positioning and Crowd Detection

Deep-Crowd-Label: A Deep-Learning based Crowd-Assisted System for Location Labeling 195

Mo Mahdi Moazzami, Jasvinder Singh and Vijay Srinivasan (Samsung Research America, USA);

Guoliang Xing (Michigan State University, USA)

Extracting Point of Interest and Classifying Environment for Low Sampling Crowd Sensing Smartphone Sensor Data 201

Billy Pik Lik Lau, Marakkalage Hasala and Sanjana Viswanath (Singapore University of

Technology and Design, Singapore); Thirunavukarasu Balasubramaniam (Queensland University of

Technology, Australia); Chau Yuen and Belinda Yuen (Singapore University of Technology and Design, Singapore); Nayak Richi (Queensland University of Technology, Australia)

Towards a Crowdsourced Radio Map for Indoor Positioning System 207

Ran Guan and Robert Harle (University of Cambridge, United Kingdom)

Crowd and Event Detection by Fusion of Camera Images and Micro Blogs 213

Sohei Kojima, Akira Uchiyama, Masumi Shirakawa, Akihito Hiromori, Hirozumi Yamaguchi and Teruo Higashino (Osaka University, Japan)

Monday, March 13, 13:15 - 14:45

CASPer-S2: Technical Session 2: Privacy, Role-Assignment and Visualization

An aggregation and visualization technique for crowdsourced continuous monitoring of transport infrastructures 219

Fatjon Seraj, Nirvana Meratnia and Paul Havinga (University of Twente, The Netherlands)

Effective Role-Assignment for Participatory Sensing Systems 225

Anubhuti Garg (University of Ottawa, Canada); Amiya Nayak (SITE, University of Ottawa, Canada)

Privacy in Context-aware Mobile Crowdsourcing Systems 231

Thivya Kandappu, Archan Misra and Shih-Fen Cheng (Singapore Management University, Singapore); Hoong Chuin Lau (SMU, Singapore)

An Open Framework for Flexible Plug-in Privacy Mechanisms in Crowdsensing Applications 237

Manos Katsomallos (ETIS/ENSEA - University of Cergy-Pontoise - CNRS UMR 8051, France); Spyros Lalis (University of Thessaly, Greece); Thanasis Papaioannou (Center for Research and Technology Hellas, Greece); George Theodorakopoulos (Cardiff University, United Kingdom)

Monday, March 13, 15:15 - 16:15

CASPer-S3: Panel

13th Workshop on Context and Activity Modeling and Recognition - Program

Monday, March 13, 08:45 - 09:00

CoMoRea: Welcome to CoMoRea'17

Monday, March 13, 09:00 - 10:00

CoMoRea-keynote: CoMoRea Keynote

Social Context Modelling and Recognition: Current Work and Future Directions

Prof. Jiannong Cao

Chair: Christian Becker (Universität Mannheim, Germany)

Social context is important to a variety of significant applications such as business intelligence, public security and epidemic. For example, companies can refine the advertisement strategy by targeting the influential people within the social group. Social context modelling and recognition is an emerging research area which aims to infer the information that characterizes multiple users such as social tie and group behaviors. Recently, new opportunities are opened up to obtain social context due to the unprecedented growth of the adoption of sensor-rich smart phones, the large scale deployment of a variety of sensor networks and the popularity of social network services. Those ambient physical and cyber sensors are able to collect users' large amount of digital traces, from which users' social context can be inferred. However, it also raises many new challenges due to the complexity and heterogeneity of the underlying platforms as well as the unique feature of multiple-user context. In this talk, I will introduce the recent advances in social context modelling and recognition. I will highlight key issues and discuss the opportunities that social context modelling and recognition may bring and future research directions. Finally, I will briefly describe our recent work on social context modelling and recognition.

Social Context Modelling and Recognition: Current Work and Future Directions 243

Jiannong Cao (Hong Kong Polytechnic Univ, Hong Kong)

Monday, March 13, 10:30 - 12:00

CoMoRea-S1: Context-Awareness

Smartphone-based Mobile Gunshot Detection 244

David Welsh and Nirmalya Roy (University of Maryland Baltimore County, USA)

Context-Based Conflict Management in Pervasive Platforms 250

Rania Ben hadj (LIG & Orange, France); Catherine Hamon (Orange, France); Stéphanie Chollet and German Vega (LIG, France); Philippe Lalanda (Grenoble University, France)

A self-aware approach to context management in pervasive platforms 256

Eva Gerbert-Gaillard, Jérémie Demarchez and Philippe Lalanda (Université Grenoble Alpes - LIG, Grenoble, France); Stéphanie Chollet (Université Grenoble Alpes - LCIS, Valence, France)

Monday, March 13, 13:15 - 14:45

CoMoRea-S2: Activity-Recognition and Modeling

Using Change Point Detection to Automate Daily Activity Segmentation 262

Samaneh Aminikhanghahi and Diane J. Cook (Washington State University, USA)

Detecting Physical Collaborations in a Group Task Using Body-Worn Microphones and Accelerometers 268

Jamie A Ward (DFKI, United Kingdom); Paul Lukowicz and Gerald Pirkl (DFKI and University of Kaiserslautern, Germany); Peter Hevesi (German Research Center for Artificial Intelligence (DFKI), Germany)

Non-wearable UWB Sensor to Detect Falls in Smart Home Environment 274

Ghassem Mokhtari (CSIRO, Australia); Qing Zhang (CSIRO ICT Centre, Australia); Amir Fazlollahi (CSIRO, Australia)

Monday, March 13, 15:15 - 15:45

CoMoRea-S3: Activity-Recognition and Modeling - cont.

Detecting spontaneous collaboration in dynamic group activities from noisy individual activity data 279

Agnes Grünerbl (DFKI German Research Center for Artificial Intelligence, Germany); Gernot Bahle (DFKI, Germany); Paul Lukowicz (DFKI and University of Kaiserslautern, Germany)

Monday, March 13, 15:45 - 17:00

CoMoRea-S4: Special Track Pervasive Energy Services (PerEnergy)

Chairs: Frank Dürr (University of Stuttgart, Germany), Delphine Reinhardt (University of Bonn and Fraunhofer FKIE, Germany)

How Many Watts: A Data Driven Approach to Aggregated Residential Air-Conditioning Load Forecasting 285

Clement Lork (Singapore University of Technology and Design & 3M, Singapore); Batchu Rajasekhar (Indian Institute of Technology Gandhinagar, India); Chau Yuen (Singapore University of Technology and Design, Singapore); Naran M. Pindoriya (Iit Gandhi nagar, India)

Cost-Aware Virtual Machine Allocation for Off-Grid Green Data Centers 291

Tingting Zhu (Southeast University, P.R. China); Hai Wang (Saint Mary's University, Canada); Haikun Wei (Southeast University, P.R. China)

2017 Workshop on Data Analytics for Mobile Networking - Program

Friday, March 17, 09:15 - 10:00

DAMN-keynote (DAMN! 2017): Keynote speech

Tracking and Optimizing Quality of Experience in the Encrypted Internet

M. Zubair Shafiq

Chair: Marco Fiore (National Research Council of Italy, Italy)

Quality-to-Experience (QoE) refers to users' experience when using an application. Network operators typically focus on Quality-of-Service (QoS) metrics such as throughput, delay, and packet loss. However, these QoS metrics only matter if they impact users' experience of the application they are using. Therefore, it is crucial for network operators to monitor Quality of Experience (QoE). However, the proliferation of end-to-end encryption has hampered the ability of network operators to monitor QoE and deploy network management techniques to mitigate QoE impairments. In this talk, Prof. Shafiq will discuss the challenges faced by network operators to effectively manage their networks given the increased end-to-end encryption on the Internet.

Tracking and Optimizing Quality of Experience in the Encrypted Internet 296

M. Zubair Shafiq (University of Iowa, USA)

Friday, March 17, 10:30 - 12:00

DAMN-S1 (DAMN! 2017): Operator-collected data analysis

Chair: Razvan Stanica (INSA Lyon, France)

Identification of Tidal-Traffic Patterns in Metro-Area Mobile Networks via Matrix Factorization Based Model 297

Sebastian Troia (Politecnico di Milano, Italy); Sheng Gao (University of Posts and Telecommunications, P.R. China); Rodolfo Alvizu, Guido Maier and Achille Pattavina (Politecnico di Milano, Italy)

Towards an Adaptive Completion of Sparse Call Detail Records for Mobility Analysis 302

Guangshuo Chen and Aline Carneiro Viana (INRIA, France); Carlos Sarraute (Grandata Labs, Argentina)

Visualizing and Analyzing Georeferenced Workloads Of Mobile Networks 306

Wender Xavier, Faber Xavier and Humberto T. Marques-Neto (Pontifical Catholic University of Minas Gerais, Brazil)

Friday, March 17, 13:15 - 14:45

DAMN-S2 (DAMN! 2017): Device-collected data analysis

Chair: Marco Fiore (National Research Council of Italy, Italy)

Crowdsensing Mobile Content and Context Data: Lessons Learned in the Wild 311

Katia Jaffrès-Runser and Gentian Jakllari (University of Toulouse, France); Tao Peng and Vlad Nitu (Université de Toulouse, France)

Sensitivity to Web Hosting in a Mobile Field Survey 316

Laurent Schumacher (UNamur, Belgium); Marie-Ange Remiche (FUNDP - The University of Namur, Belgium)

Localisation based on Wi-Fi fingerprints: a crowdsensing approach with a device-to-device aim 321

Patrice Raveneau (Univ La Rochelle, L3i, France); Stephane D'Alu (INSA Lyon, France); Herve Rivano (Inria & Université de Lyon, INRIA, INSA Lyon, CITI, France)

1st Workshop on emotion awareness for pervasive computing with mobile and wearable devices 2017 - Program

Friday, March 17, 09:00 - 10:00

EmotionAware-keynote: Opening and Keynote Speaker 1

User Responses to Social Robots - Experimental Insights and Psychophysiological Measures

Prof. Ruth Maria Stock

Chair: Klaus David (University of Kassel, Germany)

Companies in China, Japan and USA started introducing social robots at the customer interface in various industries, such as hospitality services, retailing, and health care services. In contrast to production robots, social robots are humanoid and communicate with speech and gestures with the primary purpose to interact with humans. While the prevalence of social robots is increasing, knowledge about the user acceptance of these robots is scarce. Based on an experimental series, potential stressors as well as emotional and behavioral user responses to the interaction with a social robot are examined. The experimental setting was a hotel reception, in which participants had to interact with the social robot (i.e., the humanoid robot Pepper) in the role of a hotel guest. Participants' psychological responses to the social robot were assessed via self-assessments of the participants. Beyond these standard measures, external raters evaluated the participants' responses by evaluating their facial expressions and gestures on the basis of the video recordings of the experimental procedure. Furthermore, a non-intrusive wearable device, Empatica E4, was used to measure physiological data, in particular heart rate (HR), heart rate variability (HRV) and electrodermal activity (EDA). Results show that participants were able to clearly recognize robotic emotions and behaviors. Furthermore, we could reveal similar patterns within a human-robot-interaction as compared to human-human-interactions.

User Responses to Social Robots - Experimental Insights and Psychophysiological Measures 326

Ruth Stock (Technische Universität Darmstadt, Germany)

Friday, March 17, 10:30 - 12:00

EmotionAware-S1: Session 1

Chair: Klaus David (University of Kassel, Germany)

A Mobile Lifelogging Platform to Measure Anxiety and Anger During Real-Life Driving 327

Chelsea Dobbins and Stephen Fairclough (Liverpool John Moores University, United Kingdom)

Towards Using Situational Information to Detect an Individual's Perceived Stress Level 333

Svenja Neitzel, Frank Englert, Rahul Dwarakanath, Katharina Schneider, Kathrin Reinke and Gisela Gerlach (Technische Universität Darmstadt, Germany); Christoph Rensing (Technical

University of Darmstadt & Multimedia Communications Lab, Germany); Doreen Böhnstedt and Ruth Stock (Technische Universität Darmstadt, Germany)

A Service Robot Acceptance Model: User Acceptance of Humanoid Robots During Service Encounters 339

Ruth Stock and Moritz Merkle (Technische Universität Darmstadt, Germany)

Friday, March 17, 13:15 - 14:15

EmotionAware-keynote2: Keynote Speaker 2

Friday, March 17, 14:15 - 14:45

EmotionAware-S2: Session 2

Chair: Tadashi Okoshi (Keio University, Japan)

From the Lab to the Real-world: an Investigation on the Influence of Human Movement on Emotion Recognition using Physiological signals 345

Yaqian Xu, Isabel F Hübener, Ann-Kathrin Seipp, Sandra Ohly and Klaus David (University of Kassel, Germany)

Friday, March 17, 15:15 - 16:15

EmotionAware-S3: Session 3

Chair: Chelsea Dobbins (Liverpool John Moores University, United Kingdom)

EmoBGM: estimating sound's emotion for creating slideshows with suitable BGM 351

N'djabli cedric ange Konan and Hirohiko Suwa (Nara Institute of Science and Technology, Japan); Yutaka Arakawa (Nara Institute of Science and Technology & NAIST, Japan); Keiichi Yasumoto (Nara Institute of Science and Technology, Japan)

Interruptibility Map: Geographical Analysis of Users' Interruptibility in Smart Cities 357

Mikio Obuchi, Tadashi Okoshi, Takuro Yonezawa, Jin Nakazawa and Hideyuki Tokuda (Keio University, Japan)

Friday, March 17, 16:15 - 17:00

EmotionAware-S4: Discussion Session and closing

The 8th International Workshop on Information Quality and Quality of Service for Pervasive Computing 2017 - Program

Friday, March 17, 09:00 - 10:00

IQ2S-keynote: Keynote talk

Mani Srivastava

Rich high-frequency multi-modal sensor data streams, continually captured by mobile, embedded and human sensors and processed by machine learning algorithms, are revolutionizing a range of scientific, engineering, and humanities disciplines. Innovative applications in domains such as precision medicine, energy and water management, and smart cities seek to provide new insights and trigger just-in-time interventions. Software tools and cloud services tailored to collection, transport, storage, processing, and visualization of sensory data are available.

Clearly, there has been considerable progress towards the vision of a multi-tenant pervasive substrate providing sensing as a service for applications that need awareness of the state of the natural, engineered, and social world around us. Yet, a significant challenge remains: the trust that consumers and producers of sensory data can place in this emerging pervasive sensing substrate. With diverse sensors deployed out in the wild, and sensory information traversing multiple entities along the data-to-decision pathway, decisions makers who make use of sensory data face the problem of uncertain and variable data quality, and a lack of visibility into necessary contextual information that would help explain the data and its quality. Likewise, potential data contributors with privacy concerns face the uncertainty of how their sensor data is managed downstream.

A key to addressing both these problems is to have metadata accompanying the sensor measurement values so that on the one hand downstream users gain visibility into quality and provenance of the data, and on the other hand upstream users can exercise control over how the data is handled downstream. The cyberinfrastructure underlying the pervasive sensing substrate must therefore provide run-time support for efficiently capturing, representing, propagating, querying, and reasoning about metadata relating to quality, provenance, and usage constraints associated with the sensor measurements. Furthermore, the sensor processing software must be designed so that they also derive the metadata associated with the output values they produce, taking into account not only the input values but also the input metadata.

The talk will present ideas towards architecting a sensor cyber-infrastructure that incorporates a metadata framework with the aforementioned characteristics. Across two recently funded NSF projects, mProv (<http://mprov.md2k.org>) and MetroInsight (<http://metroinsight.io>), we are working towards developing such sensor cyber-infrastructures targeting mHealth and urban area sensing application domains respectively. In these systems, the multimodal high-frequency real-time sensor data streams would not only carry sensor measurement values but also metadata relating to quality, provenance, and usage policy so that knowledge discovery and decision making can be done robustly and responsibly.

Keynote speaker: Mani Srivastava Mani Srivastava is on the faculty at UCLA where he is associated with the EE Department with a joint appointment in the CS Department. His research is broadly in the area of networked human-cyber-physical systems, and spans problems across the entire spectrum of applications, architectures, algorithms, and technologies. His current interests include issues of energy efficiency, privacy and security, data quality, and variability in the context of systems and applications for mHealth and sustainable buildings. He is a Fellow of the IEEE.

Friday, March 17, 10:30 - 11:30

IQ2S-S1: Technical Session

Chair: Shameek Bhattacharjee (Missouri University of Science and Technology, USA)

Estimation Based Adaptable Flow Aggregation Method for Reducing Control Traffic on Software Defined Wireless Networks 363

Kazuki Mizuyama (Kyushu Institute of Technology, Japan); Yuzo Taenaka (The University of Tokyo, Japan); Kazuya Tsukamoto (Kyushu Institute of Technology, Japan)

Quality of Information (QoI)-Aware Cooperative Sensing in Vehicular Sensor Networks 369

Duc Van Le and Chen-Khong Tham (National University of Singapore, Singapore); Yanmin Zhu (Shanghai Jiao Tong University, P.R. China)

W2Q: A Dual Weighted QoI Scoring Mechanism in Social Sensing using Community Confidence 375

Shameek Bhattacharjee, Nirnay Ghosh, Vijay K. Shah and Sajal K. Das (Missouri University of Science and Technology, USA)

Friday, March 17, 11:30 - 12:00

IQ2S-S2: Invited talk

Friday, March 17, 13:00 - 14:30

IQ2S-S3: Panel

PerCom Demos 2017: 2017 IEEE International Conference on Pervasive Computing and Communications Demonstrations - Program

[Welcome and Committees](#)

Tuesday, March 14, 15:50 - 16:30

Demo Teaser Madness

Tuesday, March 14, 16:30 - 19:00

Demo session (parallel)

GENI Wireless Testbed: An Open Edge Ecosystem for Ubiquitous Computing Applications 54
Abhimanyu Gosain (Raytheon BBN Technologies, USA); Ivan Seskar (WINLAB, Rutgers University, USA)

Demo Abstract: Toward Optimal Allocation of Multiple Power Resources in Energy-on-Demand Systems 57
Naoyuki Morimoto (Mie University, Japan)

SenseBox: A Low-Cost Smart Home System 60
H M Sajjad Hossain (University of Maryland Baltimore County, USA); Joseph Taylor (Washington State University, USA); Nirmalya Roy (University of Maryland Baltimore County, USA); Aryya Gangopadhyay (University of Maryland Baltimore County (UMBC), USA); Mohammad Alam (University of Maryland Baltimore County & Mobile, Pervasive and Sensor Computing Lab, USA); Md Abdullah Al Hafiz Khan (University of Maryland, Baltimore County, USA); Elizabeth Galik (University of Maryland, USA)

VIPS: A Video-Based Indoor Positioning System with Centimeter-Grade Accuracy for the IoT 63
Lien-Wu Chen, Chi-Ren Chen and Da-En Chen (Feng Chia University, Taiwan)

Field Tests and Indoor Emulation of Real-Spatial Information Based Group Communication 66
Akira Nagata (iD Corporation); Katsuichi Nakamura (iD Corporation, Japan); Hitomi Fuji, Daiki Nobayashi, Kazuya Tsukamoto and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)

Demo: Server-Assisted Interactive Mobile Simulations for Pervasive Applications 68
Christoph Dibak, Frank Dürr and Kurt Rothermel (University of Stuttgart, Germany)

DMSense: A Non-invasive Diabetes Mellitus Classification System Using Photoplethysmogram Signal 71
Vempada Ramu Reddy, Anirban Dutta Choudhury and Parijat Deshpande (Tata Consultancy Services, India); Jayaraman Srinivasan (TCS Innovation Labs, Bangalore, TCS, India); Naveen

Kumar Thokala (TCS Research and Innovation Lab, India); Venkatesh Kaliaperumal (Institute of Ayurveda and Integrative Medicine Sciences, India)

Device Installation in Smart Homes 74

Philippe Lalanda (Grenoble University, France); Catherine Hamon (Orange, France); German Vega (LIG, France); Vincent Lestideau (Grenoble University, France)

Demo of PassFrame: Generating Image-based Passwords from Egocentric Videos 76

Le Nguyen Ngu Nguyen and Stephan Sigg (Aalto University, Finland)

Argus: Smartphone-enabled Human Cooperation for Disaster Situational Awareness via MARL 79

Vidyasagar Sadhu, Gabriel Salles-Loustau, Dario Pompili and Saman Zonouz (Rutgers University, USA); Vincent Sritapan (DHS, USA)

Visualization of Events Using Twitter and Instagram 82

Prasanna Giridhar (UIUC, USA); Tarek Abdelzaher (University of Illinois, Urbana Champaign, USA)

TRAINWEAR: a Real-Time Assisted Training Feedback System with Fabric Wearable Sensors 85

Bo Zhou (German Research Center for Artificial Intelligence, Germany); Gernot Bahle and Lorenzo Fuerg (DFKI, Germany); Monit Singh (TU Kaiserslautern, Germany); Heber Cruz (German Research Center for Artificial Intelligence, Germany); Paul Lukowicz (DFKI and University of Kaiserslautern, Germany)

Pairing Continuous Authentication with Proactive Platform Hardening 88

Ryan Johnson (Kryptowire); Rahul Murmuria and Angelos Stavrou (Kryptowire, USA); Vincent Sritapan (DHS, USA)

Proposal of Hardware Device Model for IoT Endpoint Security and Its Implementation 91

Ryota Jinnai (Nara Institute of Science and Technology, Japan); Atsuo Inomata (Tokyo Denki University, Japan); Ismail Arai and Kazutoshi Fujikawa (Nara Institute of Science and Technology, Japan)

Developing Distributed Computing Applications with Tasklets 94

Janick Edinger, Dominik Schäfer and Martin Breitbach (University of Mannheim, Germany); Christian Becker (Universität Mannheim, Germany)

PerCom PhD Forum 2017: Nineteenth Annual PhD Forum on Pervasive Computing and Communications, 2017 - Program

[Welcome and Committees](#)

Tuesday, March 14, 13:00 - 13:15

PhD Forum Teaser Madness

Tuesday, March 14, 16:30 - 19:00

PhD Forum session (parallel)

Towards Real World Activity Recognition from Wearable Devices 97

Timo Sztyler (University of Mannheim, Germany)

Context-Aware Multi-Inhabitant Functional and Physiological Health Assessment in Smart Home Environment 99

Mohammad Alam (University of Maryland Baltimore County & Mobile, Pervasive and Sensor Computing Lab, USA)

Energy-efficient Acoustic Communication Using Vibration Energy Harvesting 101

Guohao Lan (University of New South Wales, Australia)

Mobile Sensing for Social Interaction Monitoring and Modelling 103

Alessandro Montanari (University of Cambridge, United Kingdom)

Behavioral Monitoring in Smart-Home Environments for Health-Care Applications 105

Gabriele Civitarese (University of Milan, Italy)

Establishing Trust in Heterogeneous Networks 107

Dominik Schürmann (Technische Universität Braunschweig, Germany)

Practical Visible Light Communication System Utilizing LED Sensing 109

Yanbing Yang (Nanyang Technological University, Singapore)

Second IEEE PerCom Workshop on Pervasive Health Technologies 2017 - Program

Monday, March 13, 09:00 - 09:05

PerHealth-S1: Welcome To PerHealth 2017

Manfred Huber

Chair: Manfred Huber (The University of Texas at Arlington, USA)

Dr. Manfred Huber introduces the program and welcomes our keynote speaker: Dr. Claudion Bettini.

Monday, March 13, 09:05 - 10:00

PerHealth-keynote: Keynote: Personal data protection in pervasive health systems

Claudio Bettini

Chair: Manfred Huber (The University of Texas at Arlington, USA)

Pervasive computing is increasing its impact in several areas related to health-care and well-being. Data collected from sensors in smart-homes are being processed to continuously recognize activities, change of habits, and critical events leading to innovative applications in monitoring patients with chronic diseases, elderly at risk of cognitive decline, and enable new opportunities for active aging. Data collected from wireless medical devices, smart- phones and watches complement data from environmental sensors to continuously collect an increasingly rich "personal medical context". Storing, processing, and analyzing this sensitive information often implies the use of distributed architectures and the exposure to multiple parties. The data protection issues studied for handling and sharing Electronic Medical Records (EMR) have to be faced in this context too, and pose new challenges due to the extremely dynamic nature of this data and to the volume of collected data. While data analysis for scientific research may benefit from privacy preserving data mining techniques or differential privacy approaches, personalized medicine and monitoring require data specific to an individual to be preserved.

Personal data protection in pervasive health systems 381

Claudio Bettini (University of Milan, Italy)

Monday, March 13, 10:30 - 12:00

PerHealth-S2: Intelligent Environments and Interfaces

Chair: Manfred Huber (The University of Texas at Arlington, USA)

EyeAssist: A Communication Aid through Gaze Tracking for Patients with Neuro-Motor Disabilities 382

Anwasha Khasnobish (TCS, India); Rahul Gavas (Tata Consultancy Services, India); Debatri Chatterjee (TCS Innovation Lab, India); Ved Raj and Sapna Naitam (TCS, India)

Monitoring Objects Manipulations to Detect Abnormal Behaviors 388

Gabriele Civitarese and Claudio Bettini (University of Milan, Italy)

SmartCare: an Introduction 394

Gergely Zaruba, Manfred Huber and Nicholas Burns (University of Texas at Arlington, USA);
Kathryn Daniel (The University of Texas at Arlington, USA)

Monday, March 13, 13:30 - 15:00

PerHealth-S3: Technologies for Nutrition Monitoring

Chair: Manfred Huber (The University of Texas at Arlington, USA)

SwallowNet: Recurrent Neural Network Detects and Characterizes Eating Patterns 401

Dzung Tri Nguyen, Nabil Alshurafa and Eli Cohen (Northwestern University, USA)

Investigating Barriers and Facilitators to Wearable Adherence in Fine-Grained Eating Detection 407

Rawan Alharbi, Nilofar Vafaie, Kitty Liu, Kevin Moran, Gwendolyn Ledford, Angela Pfammatter,
Bonnie Spring and Nabil Alshurafa (Northwestern University, USA)

**Swallowing Detection for Game Control: Using Skin-Like Electronics to Support People with
Dysphagia 413**

Benjamin Nicholls (University of Kent, United Kingdom); Yongkuk Lee and Woon Yeo (Virginia
Commonwealth University, USA); Chee Ang and Christos Efstratiou (University of Kent, United
Kingdom)

Monday, March 13, 15:30 - 17:00

PerHealth-S4: Sensors and Systems

Chair: Gergely Zaruba (University of Texas at Arlington, USA)

Smart Cushion: A Practical System for Fine-grained Sitting Posture Recognition 419

Guanqing Liang (The Hong Kong Polytechnic University, Hong Kong); Jiannong Cao (Hong Kong
Polytechnic Univ, Hong Kong); Xuefeng Liu (The Hong Kong Polytechnic University, Hong Kong)

**Measuring Changes in Gait and Vehicle Transfer Ability During Inpatient Rehabilitation with
Wearable Inertial Sensors 425**

Gina Sprint, Vladimir Borisov and Diane J. Cook (Washington State University, USA); Douglas
Weeks (St. Luke's Rehabilitation Institute, USA)

**ActivityAware: An App for Real-Time Daily Activity Level Monitoring on the Amulet Wrist-
Worn Device 431**

George Boateng (DARTMOUTH COLLEGE, USA); Ryan Halter (Dartmouth College, USA); John
Batsis (DARTMOUTH COLLEGE, USA); David Kotz (Dartmouth College, USA)

First International Workshop on Mobile and Pervasive Internet of Things'17 - Program

Monday, March 13, 08:45 - 10:00

PerIoT-keynote: Keynote Talk

Pushing Down User Information to Enhance Smart Device System Design

Dr. Gang Zhou

Chair: Farzana Rahman (James Madison University, USA)

Recent popularity in smart devices, for example smartphones, has created an increased interest in carrying small devices with limited battery capacity. Unfortunately, smartphones are notorious for consuming energy far too quickly. Although certain advances have been made on the hardware side such as better batteries, this talk is focused on improving energy management software in the lower layer system to make better use of existing batteries. For modern smartphone, a major cause of battery drain is wireless communications. Most smartphones come equipped with multiple radio transceivers, such as Bluetooth, GPS, WiFi and 4G, among which power hungry WiFi or 4G radios are required for access to the Internet. The frequency of use of these radios is spurred by the popularity of smartphone applications, and many applications require the phone to be constantly connected to the Internet. The wide availability of applications, for instance the Android Market has over 700K registered applications, shows that the need to save smartphone radio energy is highly relevant and urgent today. While significant research over the past has been done regarding energy savings in smartphones, our research in this talk aims to save smartphone radio energy with a network traffic aware approach. Two major research challenges are addressed: (1) Some applications with delay sensitive data should be processed as such, while others such as advertisements in smartphone video games are delay tolerant allowing us to save energy. How can the priority be determined, and how can we use the priority to save energy for only those applications that are delay tolerant? (2) Network traffic of real-time applications is delay sensitive. How can it be communicated while keeping the delay sensitivity in mind and still saving energy? While delay sensitive traffic must be communicated with best performance in mind, performance based communication, however, has a significant energy cost. In order to save energy, special care must be taken to ensure that the radio is placed into low power mode only during periods of time when nothing meaningful is in transmission. To address these challenges, I will present two research results: exploiting application priority with machine learning for energy savings, and exploiting delay tolerant time periods within high priority applications, such as real-time applications, for energy savings. If time allows, I will also present another work that uses a learning-based approach to analyze disk rather than network I/O traffic from users to optimize lower layer system design for smartphone energy savings.

Pushing Down User Information to Enhance Smart Device System Design 436

Gang Zhou (College of William and Mary, USA)

Monday, March 13, 10:30 - 12:00

PerIoT-S1: IoT Applications

Chair: Samy S. El-Tawab (James Madison University, USA)

Daily Living Activity Recognition with ECHONET Lite Appliances and Motion Sensors 437

Kazuki Moriya, Eri Nakagawa, Manato Fujimoto and Hirohiko Suwa (Nara Institute of Science and Technology, Japan); Yutaka Arakawa (Nara Institute of Science and Technology & NAIST, Japan); Aki Kimura and Satoko Miki (Mitsubishi Electric Corporation, Japan); Keiichi Yasumoto (Nara Institute of Science and Technology, Japan)

Characterizing Road Segments Using Compass Sensors to Predict Approaching Bus Stops 443

Danila Chenchik, Jia Chen and Stephen Yan (University of North Carolina at Chapel Hill, USA); Shahriar Nirjon (University of North Carolina at Chapel Hill)

A Wireless IoT System Towards Gait Detection in Stroke Patients 449

AKM Jahangir Alam Majumder and Yosuf ElSaadany (Miami University, USA); Mohammed ElSaadany (Miami University, Oxford, Ohio, USA); Donald Ucci (Miami University, USA); Farzana Rahman (James Madison University, USA)

Context-Aware and User-Centric Residential Energy Management 455

Baris Aksanli (San Diego State University, USA); Jagannathan Venkatesh (UCSD, USA); Christine Chan (University of California, San Diego, USA); Alper Sinan Akyurek (University of California - San Diego, USA); Tajana Simunic Rosing (University of California, San Diego, USA)

Monday, March 13, 13:15 - 14:45

PerIoT-S2: Protocols and Services for IoT

Delay Tolerant Routing Protocol for Heterogeneous Marine Vehicular Mobile Ad-hoc Network 461

Subhasri Duttagupta (Tata Consultancy Services, India); Maneesha Vinodini Ramesh (Amrita Vishwa Vidyapeetham, Amrita University, India); Dhanesh Raj (Amrita Vishwa Vidyapeetham, India)

Maximizing Coverage in Low-Power Wide-Area IoT Networks 467

Alan Marchiori (Bucknell University, USA)

The Hint Protocol: Using a broadcast method to enable ID-free data transmission for dense IoT devices 473

Yi Ren and Ren-Jie Wu (National Chiao Tung University, Taiwan); Yu-Chee Tseng (National Chiao-Tung University, Taiwan)

Large-scale Offloading in the Internet of Things 479

Huber Flores, Xiang Su and Vassilis Kostakos (University of Oulu, Finland); Aaron Yi Ding (Technical University of Munich, Germany); Petteri Nurmi (Helsinki Institute for Information Technology HIIT, Finland); Sasu Tarkoma (University of Helsinki, Finland); Pan Hui (Hong Kong)

University of Science and Technology & Telekom Innovation Laboratories, Hong Kong); Yong Li (Tsinghua University, P.R. China)

Monday, March 13, 15:15 - 16:30

PerIoT-S3: Design and Analysis of IoT Components

Chair: AKM Jahangir Alam Majumder (Miami University, USA)

RoCoSys: A Framework for Coordination of Mobile IoT Devices 485

Christian Krupitzer, Martin Breitbach and Johannes Saal (University of Mannheim, Germany);
Christian Becker (Universität Mannheim, Germany); Michele Segata and Renato Lo Cigno
(University of Trento, Italy)

Design and Verification of IEEE 802.11ah for IoT and M2M Applications 491

Rami Akeela (Santa Clara University, USA); Yacoub Elziq (JimzuTech, USA)

Data Analysis of Transit Systems Using low-cost IoT Technology 497

Samy S. El-Tawab, Raymond Oram, Michael Garcia and Chris Johns (James Madison University, USA); B. Brian Park (University of Virginia, USA)

The First International Workshop on Pervasive Smart Living Spaces 2017 - Program

Monday, March 13, 08:30 - 10:00

PerLS-S1: Smart Spaces

Chair: Andreas Jacobsson (Malmö University, Sweden)

The Smart Object Description Language: Modeling Interaction Capabilities for Self-Reflection 503

Daniel Burmeister (University of Lübeck, Germany); Florian Burmann (Universität zu Lübeck, Germany); Andreas Schrader (University of Lübeck, Germany)

Understanding Ride-on-demand Service: Demand and Dynamic Pricing 509

Suiming Guo (The Chinese University of Hong Kong, Hong Kong); Yaxiao Liu (Shenzhen UCar, P.R. China); Ke Xu (Tsinghua University, P.R. China); Dah Ming Chiu (The Chinese University of Hong Kong, Hong Kong)

Integration of Smart Home Technologies for District Heating Control in Pervasive Smart Grids 515

Radu-Casian Mihailescu (Malmö University, Sweden); Paul Davidsson (Malmö University, Sweden)

Monday, March 13, 10:30 - 12:00

PerLS-S2: Identification Systems

Chair: Nirmalya Roy (University of Maryland Baltimore County, USA)

Personal Identification System Based on Rotation of Toilet Paper Rolls 521

Masaya Kurahashi (Kobe University, Japan); Kazuya Murao (Ritsumeikan University, Japan); Tsutomu Terada and Masahiko Tsukamoto (Kobe University, Japan)

The Carpet Knows: Identifying People in a Smart Environment from a Single Step 527

Bo Zhou (German Research Center for Artificial Intelligence, Germany); Monit Singh, Sugandha Doda and Muhammet Yildirim (TU Kaiserslautern, Germany); Jingyuan Cheng (TU Braunschweig, Germany); Paul Lukowicz (DFKI and University of Kaiserslautern, Germany)

A User Identification Method Based on Features of Opening/Closing a Refrigerator Door 533

Akane Ishida (Kobe University, Japan); Kazuya Murao (Ritsumeikan University, Japan); Tsutomu Terada and Masahiko Tsukamoto (Kobe University, Japan)

Monday, March 13, 13:00 - 14:00

PerLS-S3: Activity Recognition

Toward Real-Time In-Home Activity Recognition Using Indoor Positioning Sensor and Power Meters 539

Eri Nakagawa, Kazuki Moriya, Hirohiko Suwa and Manato Fujimoto (Nara Institute of Science and Technology, Japan); Yutaka Arakawa (Nara Institute of Science and Technology & NAIST, Japan); Keiichi Yasumoto (Nara Institute of Science and Technology, Japan)

TransAct: Transfer Learning Enabled Activity Recognition 545

Md Abdullah Al Hafiz Khan (University of Maryland, Baltimore County, USA); Nirmalya Roy (University of Maryland Baltimore County, USA)

Monday, March 13, 14:00 - 15:00

PerLS-S4: Security in Smart Systems

Chair: Kazuya Murao (Ritsumeikan University, Japan)

Securing Vulnerable Home IoT Devices with an In-Hub Security Manager 551

Anna Simpson, Franziska Roesner and Tadayoshi Kohno (University of Washington, USA)

An Analysis of Malicious Threat Agents for the Smart Connected Home 557

Joseph Bugeja (Malmo University, Sweden); Andreas Jacobsson and Paul Davidsson (Malmö University, Sweden)

Monday, March 13, 15:30 - 17:00

PerLS-S5: Panel

Privacy Challenges in Pervasive Living Spaces

Chair: Mohan J Kumar (Rochester Institute of Technology, USA)

The First International Workshop on Smart Edge Computing and Networking 2017 - Program

Friday, March 17, 08:30 - 10:00

SmartEdge-keynote: Opening and Keynote Speaker

Cyber-Physical Systems for Mobile Health, Environmental Monitoring, and Datacenter Management:
An Edge Computing Approach
Guoliang Xing

Abstract: A key global challenge today is to deliver high quality yet economically efficient healthcare solutions. The prominence of mobile technologies holds the promise of fundamentally transforming today's reactive, hospital-centered healthcare practice to proactive, individualized care, and shifting the focus from disease to wellbeing. In the first part of this talk, I will discuss our work on personalized, in-place monitoring of human biological rhythms. Biological rhythms play a central role in maintaining our daily productivity and well-being, and can be found in almost every essential human body function. We have developed several novel mobile health systems for monitoring important biological rhythms including sleep/wakefulness, respiration, walking/running etc. These systems leverage sensing modalities of pervasive edge devices, computing resources on the cloud, and psychological/physiological models to empower individuals to improve their health.

In the second part of this talk, I will describe the cyber-physical systems that we developed for real-time volcano tomography, aquatic monitoring, and data center thermal management. Volcanic eruptions have become major natural hazards due to ever growing urbanization. We have developed new sensor systems for real-time volcano tomography, which have been field deployed on two active volcanoes in Ecuador and Chile. Aquatic environment is facing increasing threats from climate change, industrial pollution, and improper waste disposal. I will discuss our work on debris detection using a new smartphone-based robot system. Data centers are a critical infrastructure in the era of cloud and edge computing. I will describe a novel system for datacenter energy/thermal management, which integrates computational modeling, in situ wireless sensing, and real-time prediction and control.

Lastly, I will discuss a genic edge computing platform called ORBIT that has been adopted in several applications described above. ORBIT provides intelligent task partitioning/dispatching mechanisms and annotation-based programming primitives for supporting a broad class of applications that run across the cloud and edge devices.

Friday, March 17, 10:30 - 12:00

SmartEdge-S1: Session 1: Edge Communication/Infrastructure

Loquat: A Framework for Large-Scale Actor Communication on Edge Networks 563

Peter Van Roy and Christopher Meiklejohn (Université Catholique de Louvain, Belgium)

OpenChirp: A Low-Power Wide-Area Networking Architecture 569

Adwait Dongare and Anthony Rowe (Carnegie Mellon University, USA)

MetroSDX: A Resilient Edge Network for the Smart Community 575

Sean Donovan, Joaquin Chung and Matt Sanders (Georgia Institute of Technology, USA); Russell J Clark (Georgia Tech, USA)

Friday, March 17, 13:15 - 14:45

SmartEdge-S2: Session 2: Edge Resource Management

Accuracy-Resource Tradeoff for Edge Devices in Internet of Things 581

Nima Mousavi (University of California, San Diego, USA); Baris Aksanli (San Diego State University, USA); Alper Sinan Akyurek (University of California - San Diego, USA); Tajana Simunic Rosing (University of California, San Diego, USA)

Latency Aware Mobile task Assignment and Load balancing for Edge Cloudlets 587

Vinay Chamola and Chen-Khong Tham (National University of Singapore, Singapore); Sai Sesha G (Birla Institute of Technology and Science, India)

Towards edge-caching for image recognition 593

Utsav Drolia (Carnegie Mellon University, USA); Katherine Guo (Bell Labs, USA); Jiaqi Tan, Rajeev Gandhi and Priya Narasimhan (Carnegie Mellon University, USA)

Friday, March 17, 15:15 - 16:15

SmartEdge-S3: Session 3

A City Edge Cloud with its Economic and Technical Considerations 599

Glenn Ricart (US Ignite, USA)

Design and Implementation of IoT-Based HVAC System for Future Zero Energy Building 605

Myeong-in Choi, Keonhee Cho and Jun Yeon Hwang (Chung-Ang University, Korea); Lee Won Park (ChungAng University, Korea); Sehyun Park, Kyu Hee Jang and Sunghwan Park (Chung-Ang University, Korea)

Friday, March 17, 16:15 - 16:30

SmartEdge-close: Closing Remarks

2ND IEEE PERCOM Workshop On Security Privacy And Trust In The Internet of Things 2017 - Program

Monday, March 13, 08:50 - 10:00

SPT-IOT-keynote: Opening Keynote

Ethics and Legal Considerations in the Internet of Things (IoT)

Helaine Leggat

The Internet of things (IoT) can be perceived as a far-reaching vision with technological and societal implications. In simple terms, IoT boils down to convergence in the sense of technology and people coming together or merging. In legal terms, this IoT convergence has parallels in concepts such as accession, commixture, confusion and comingling. These legal concepts have broadly speaking, the same application within the context of property law, where property law includes real property such as land, moveable property such as chattels or things (including human tissue), and tangible and intangible property (intellectual property). On the technological side, considerable progress has been made towards IoT providing seamless communications between persons, between objects, and between persons and objects. On the societal side however, little progress has been made regarding the examination of a legal and ethical framework applicable to IoT and New Generation Networks (NGNs). Response to the October 21 2016 Distributed Denial of Service (DDoS) attacks which caused widespread disruption of legitimate internet activity in the US highlights that "we have been shown just how vulnerable the internet, which is now an integral part of the critical infrastructure of the US and many other countries, is to disruptive abuse conducted at scale, by persons whose identity is not immediately ascertainable. Until this vulnerability is addressed, it will cast a serious shadow over the future of connected technology, a future in which much hope and massive resources have already been invested." This paper seeks to highlight legal and ethical aspects of the technological and societal convergence arising from IoT and NGNs in the context of national and international law. It explores fields of law other than the law of things which may have useful application in guiding an ethical framework for IoT and NGNs and outlines an approach to maintaining a rules-based global order.

Ethics and Legal Considerations in the Internet of Things (IoT) 611

Helaine Leggat (Information Legal, Australia)

Monday, March 13, 10:30 - 12:00

SPT-IOT-S1: IoT Infrastructure Security

Toward Consumer-Friendly Security in Smart Environments 612

Ruth Ogunnaike (University of Washington, USA); Brent Lagesse (University of Washington Bothell, USA)

Blockchain for IoT Security and Privacy: The Case Study of a Smart Home 618

Ali Dorri (UNSW, Australia); Salil S Kanhere (The University of New South Wales, Australia); Raja Jurdak (Commonwealth Scientific and Industrial Research Organisation (CSIRO) ICT Centre & University of Queensland, Australia); Praveen Gauravaram (Tata Consultancy Services, Australia, Australia)

Portguard - An Authentication Tool for Securing Ports in an IoT Gateway 624

Shiju Sathyadevan (Amrita Vishwa Vidyapeetham, India); Robin Doss (Deakin University, Australia); V Vejesh (Amrita University, India); Lei Pan (Deakin University, Australia)

Monday, March 13, 13:15 - 14:45

SPT-IOT-S2: IoT Security Techniques & Methods

Preventing Shoulder Surfing using Randomized Augmented Reality Keyboards 630

Anindya Maiti, Murtuza Jadliwala and Chase Weber (Wichita State University, USA)

Shortening the Security Parameters in Lightweight WSN Applications for IoT - Lessons Learned 636

Anna Sojka-Piotrowska (IHP, Germany); Peter Langendoerfer (IHP Microelectronics, Germany)

A Novel Key Generation Algorithm from Twitter Data Stream for Secure Communication in IoT 642

Pratham Majumder (Indian Statistical Institute, India); Koushik Sinha (Southern Illinois University, USA)

Monday, March 13, 15:15 - 16:15

SPT-IOT-S3: IoT Security and Trust

A PUF Sensor: Securing Physical Measurements 648

Hua Ma and Yansong Gao (The University of Adelaide, Australia); Omid Kavehei (RMIT University, Australia); Damith C. Ranasinghe (The University of Adelaide, Australia)

TM-Coin: Trustworthy Management of TCB Measurements in IoT 654

Jaemin Park (The Affiliated Institute of ETRI, Korea); Kwangjo Kim (Korea Advanced Institute of Science and Technology, Korea)

PerCom WiP 2017: 2017 IEEE International Conference on Pervasive Computing and Communications Work in Progress - Program

[Welcome and Committees](#)

Tuesday, March 14, 15:50 - 16:30

WiP Teaser Madness

Tuesday, March 14, 16:30 - 19:00

WiP session (parallel)

Improving Smartphone Based Collision Avoidance by Using Pedestrian Context Information 2
Marek Bachmann, Michel Morold and Klaus David (University of Kassel, Germany)

Vehicular Fog Computing: Vision and Challenges 6
Yu Xiao and Chao Zhu (Aalto University, Finland)

Is Someone Moving Around My Cell-phone? Tracing Cellular Signals for Passive Motion Detection 10
Stefano Savazzi (National Research Council of Italy (CNR) & Politecnico di Milano, Italy); Sanaz Kianoush (National Research Council of Italy (CNR), Italy); Vittorio Rampa (IEIIT - CNR - Dipartimento di Elettronica e Informazione, Italy); Umberto Spagnolini (Politecnico di Milano, Italy)

Inertial Navigation Algorithms 14
Ken Mulder, Maiga Chang and Larbi Esmahi (Athabasca University, Canada); Mohamed Jemni (Research LaboratoryLaTICE & University of Tunis, Tunisia)

What's Cooking and Why? Behaviour Recognition During Unscripted Cooking Tasks for Health Monitoring 18
Kristina Yordanova (University of Rostock, Germany); Samuel Whitehouse (University of Bristol, United Kingdom); Adeline Paiement (Swansea University, United Kingdom); Majid Mirmehdi (University of Bristol, United Kingdom); Thomas Kirste (University of Rostock, Germany); Ian Craddock (University of Bristol, United Kingdom)

Challenges of Collecting Empirical Sensor Data from People with Dementia in a Field Study 22
Albert Hein, Frank Krüger, Sebastian Bader, Peter Eschholz and Thomas Kirste (University of Rostock, Germany)

Classroom Attentiveness Classification Tool (ClassACT): The System Introduction 26
Timothy P Negron and Corey Graves (North Carolina A&T State University, USA)

An Integrated Platform for Collecting Mobile Phone Data and Learning Demographic Features 30

Xuhong Zhang (University of California, Irvine, USA); Venkata Mallepudi (M2Catalyst, USA);
Carter T Butts (University of California, Irvine, USA)

Walking Speed Recognition from 5G Prototype System 34

Bahareh Gholampooryazdi and Stephan Sigg (Aalto University, Finland)

RFexpress! - RF Emotion Recognition in the Wild 38

Muneeba Raja (Aalto University Finland, Finland); Stephan Sigg (Aalto University, Finland)

Understanding Passenger Reaction to Dynamic Prices in Ride-on-demand Service 42

Suiming Guo (The Chinese University of Hong Kong, Hong Kong); Yaxiao Liu (Shenzhen UCar,
P.R. China); Ke Xu (Tsinghua University, P.R. China); Dah Ming Chiu (The Chinese University of
Hong Kong, Hong Kong)

PassFrame: Generating Image-based Passwords from Egocentric Videos 46

Le Nguyen Ngu Nguyen and Stephan Sigg (Aalto University, Finland)

Understanding Customer Behaviour in Urban Shopping Mall from WiFi Logs 50

Yuanyi Chen (SJTU, P.R. China); Jinyu Zhang (Shanghai Jiao Tong University, USA); Minyi Guo
(Shanghai Jiao Tong University, P.R. China); Jiannong Cao (Hong Kong Polytechnic Univ, Hong
Kong)

The Third IEEE International Workshop on Sensing Systems and Applications Using Wrist Worn Smart Devices, 2017 - Program

Monday, March 13, 09:00 - 10:00

WristSense-keynote: Keynote Talk

Nirmalya Roy

The U.S. Census Bureau reports that the U.S. population of people aged 65 and up will grow more than double in between 2010 and 2050. The market for remote patient monitoring is expected to grow from \$10.6 billion in 2012 to \$21.2 billion in 2017. This growing societal and economical needs revitalize the work on technology-assisted proactive and preventive health monitoring in smart home environments. In recent time the proliferation of commodity smart healthcare appliances and stand-alone and integrated sensing devices (Internet of Things) make it increasingly easier to ubiquitously and continuously monitor an individual's health-related vital signals, activities, and behaviors to provide just-in-time interventions for the aging population. Nevertheless, developing reliable and clinically equivalent point-of-care technologies to perform automated health assessment and intervention remain challenging. In this talk, I will discuss how signal processing and machine learning techniques help analyze the activity and physiological signals to gauge the cognitive and behavioral health of older adults. I will also discuss the comparative performance of technology-guided algorithmic methodology with clinically-driven survey, observation, and performance-based measurements. I will conclude the talk highlighting our experiences of deploying this smart home health service systems for Alzheimer's patients living in retirement community centers.

Keynote: Wearable and IoT for Cognitive Health Assessment: Significance and Challenges 660
Nirmalya Roy (University of Maryland Baltimore County, USA)

Monday, March 13, 10:30 - 12:00

WristSense-S1: Health and Wellbeing

HeatWatch: Preventing Heatstroke Using a Smart Watch 661
Takashi Hamatani, Akira Uchiyama and Teruo Higashino (Osaka University, Japan)

Using Wrist-worn Sensors to Measure and Compare Physical Activity Changes for Patients Undergoing Rehabilitation 667
Jordana Dahmen (Washington State University, USA); Alyssa La Fleur (Whitworth University, USA); Gina Sprint and Diane J. Cook (Washington State University, USA); Douglas Weeks (St. Luke's Rehabilitation Institute, USA)

UStress: Understanding College Student Subjective Stress Using Wrist-Based Passive Sensing 673
Begum Egilmez, Emirhan Poyraz, Wenting Zhou, Gokhan Memik, Peter Dinda and Nabil Alshurafa
(Northwestern University, USA)

Monday, March 13, 13:30 - 15:00

WristSense-S2: Interaction and Activity Recognition

A Natural Language Query Interface for Searching Personal Information on Smartwatches 679
Reza Rawassizadeh (Dartmouth College, USA); Chelsea Dobbins (Liverpool John Moores University, United Kingdom); Manouchehr Nourizadeh (Vienna University of Technology, Austria); Zahra Ghamchili (University of Vienna, Austria); Michael Pazzani (University of California, Riverside, USA)

Inferring Smartphone KeyPress via Smartwatch Inertial Sensing 685

Sougata Sen (Singapore Management University, Singapore); Karan Grover (Indraprastha Institute of Information Technology, Delhi, India); Vigneshwaran Subbaraju (NTU, Singapore); Archan Misra (Singapore Management University, Singapore)

Single BSN-Based Multi-Label Activity Recognition 691

Mohammad Alam (University of Maryland Baltimore County & Mobile, Pervasive and Sensor Computing Lab, USA); Nirmalya Roy (University of Maryland Baltimore County, USA)

Monday, March 13, 15:30 - 16:30

WristSense-S3: Wrist-based Localization

InLocW: A Reliable Indoor Tracking and Guiding System for Smartwatches with Path Re-Routing 697

Vivek Chandel (Tata Consultancy Services, India); Dibyanshu Jaiswal (Tata Consultancy Services Ltd., India); Avik Ghose (Tata Consultancy Services, India)

Size Does Matter - Positioning on the Wrist A Comparative Study: SmartWatch vs. SmartPhone 703

Gerold Hölzl and Matthias Kranz (University of Passau, Germany); Andreas Schmid, Peter Halbmayr and Alois Ferscha (Johannes Kepler University, Austria)